

Animal and human intelligence

What makes us unique?

But some animals might have evolved simpler forms...

Some animals can manage...
logical thought, reasoning,
planning, self-awareness.
They have empathy,
mourning....

The evolution of human intelligence

Ultimate causes?

Proximate causes?

Ultimate causes

1. Social brain hypothesis
2. Sexual selection hypothesis

1. Social brain hypothesis
2. Sexual selection hypothesis

Intelligence evolved as a means of surviving in large and complex social groups

1. Social brain hypothesis
2. Sexual selection hypothesis

a. **Runaway:** no direct/ indirect benefit



1. Social brain hypothesis

2. Sexual selection hypothesis

b. Good gene: against pathogens/
parasites



Proximate causes

Evolution of human brains
Evolution of human language

The search for intelligence –by Carl Zimmer Scientific American 2008

1. What is the evidence of “genetic basis of intelligence”?
2. What is intelligence? What does IQ test and g factor can tell us about intelligence?
3. Why it is difficult to find out the “intelligence genes”?
4. How does Intelligence associate with the human brains?
--brain size, cortex area, white matter.
5. How environment may play a role on intelligence?
--study of identical twins; socioeconomic status...

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Genome-wide association studies establish that human intelligence is highly heritable and polygenic

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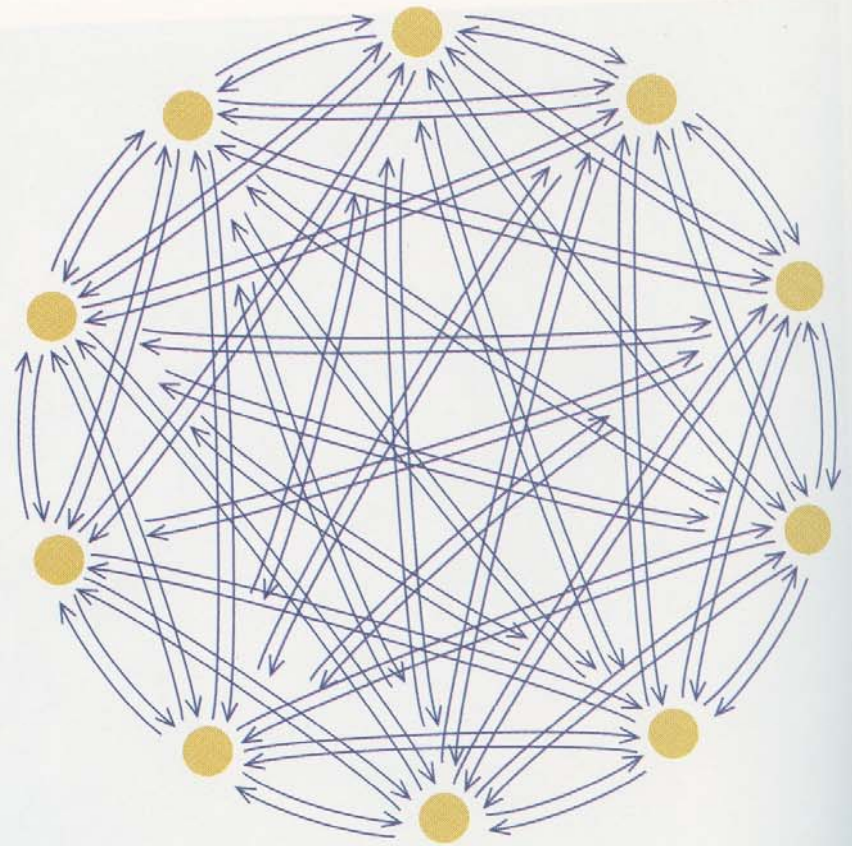
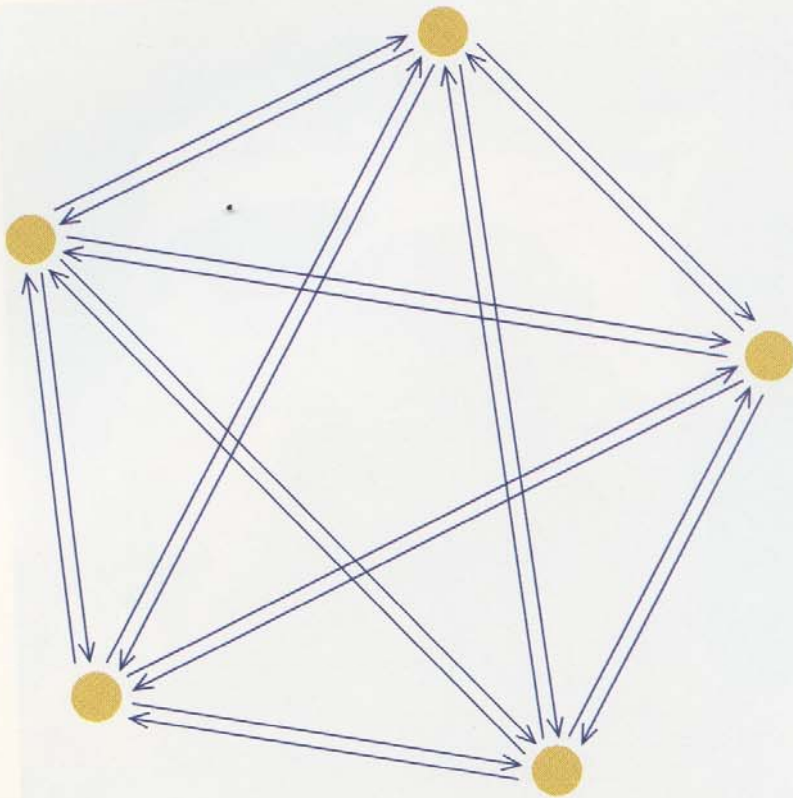
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Evolution of human brains

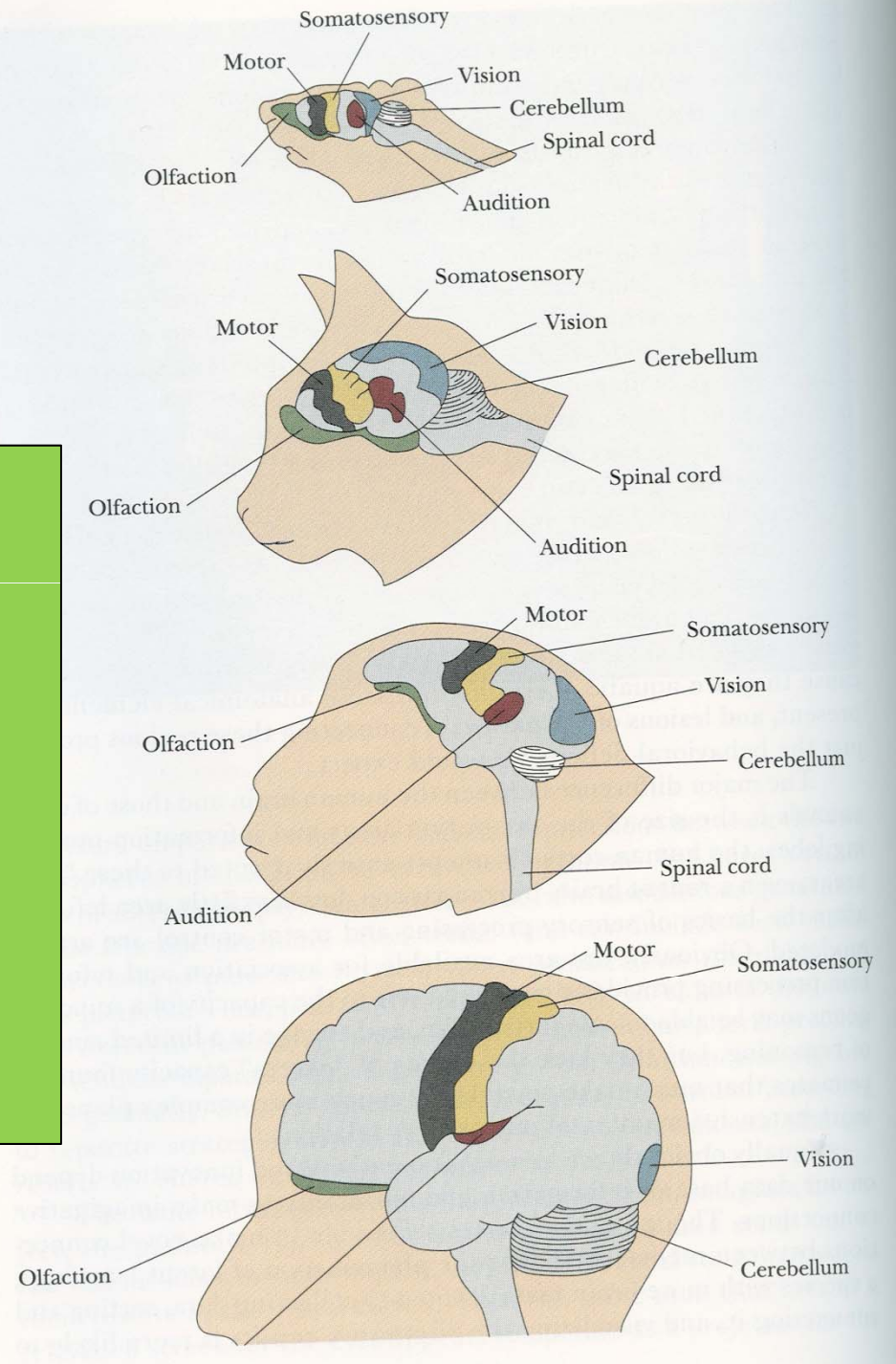
Evolution of human language

More neurons More networking



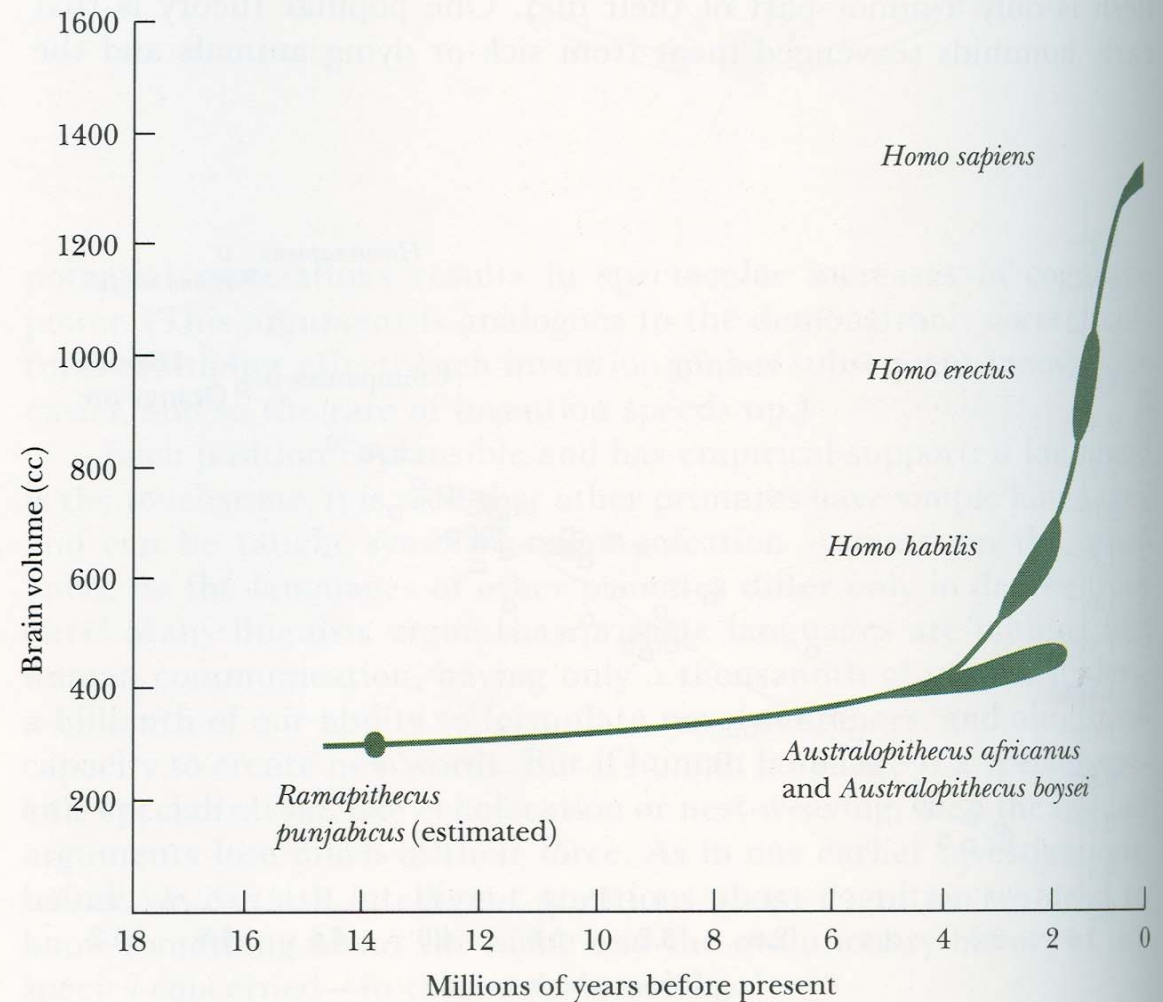
The sensory and motor areas occupy most of the brain of nearly all mammals; much of the remaining part of the cortex is devoted to making associations. Some primates have at least as much association space as sensory and motor regions combined; the highest known proportion of association area is found in humans.

More neurons in cerebral cortex, humans have much more association areas.



Bigger brain volume of *Homo sapiens*

The brain volume of the line leading to humans increased dramatically over the last 4 million years, suggesting strong selection pressure for a large nervous system.



Proximate causes

Evolution of human brains

Evolution of human language

Language is not essential for
cognition.....

Some animals can manage...
logic, thought, reasoning,
planning, self-awareness

but language has a **BIG** effect
on cognitive abilities

Language facilitates the
evolution of human
intelligence

Is spoken language
learned or innate?

Spoken language has
many innate
components

Innate components

Sound generation (consonants; vowels)

Innately recognized consonants

Innately processed vowel

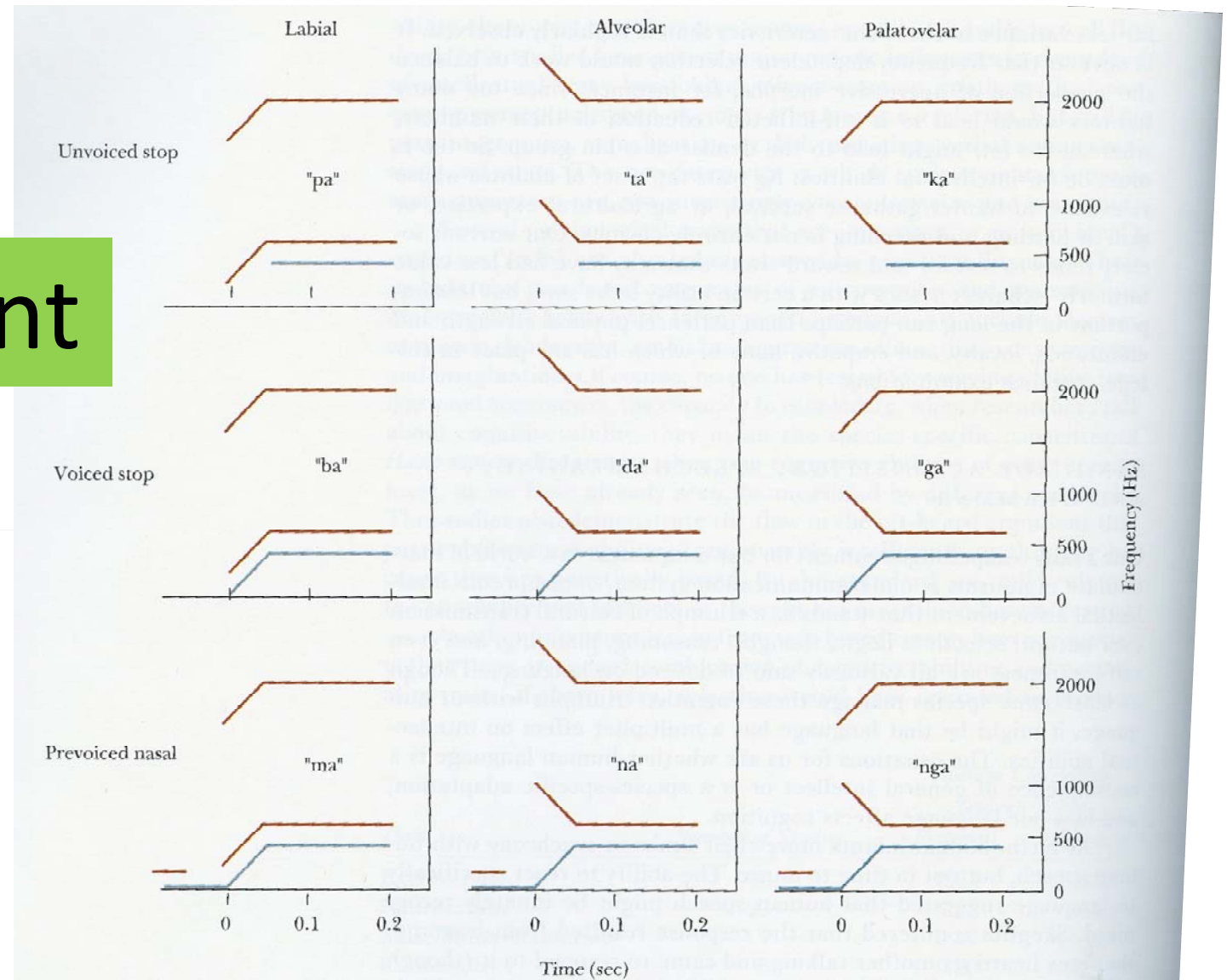
a **vowel** is a speech sound, such as English *ah!* [ɑː] or *oh!* [oʊ], pronounced with an **open** vocal tract vibration.

a **consonant** is a speech sound that is articulated with complete or partial **closure** of the vocal tract.

Syllable (vowel + consonant)

Word (syllables)

consonant



These nine consonants are distinguished by the location in the mouth where the air-flow is manipulated (the labial, alveolar, and palatovelar groups) and the relative timing of the airflow change and the voicing of the vowel in the throat (prevoiced, simultaneous voicing—"voiced"—and delayed voicing—"unvoiced"). The airflow manipulations mainly alter the form of the second and third "formants" (the upper two lines in these sonographs), while the timing of voicing is reflected in the lowest (first) formant, shown in blue.

Innate components

Sound generation (consonants; vowels)

Innately recognized consonants

Innately processed vowel

The basics of Grammar are innate

Universal grammar

Noam Chomsky: If humans growing up under normal conditions; they always develop a language with a specific property (for example, distinguishing nouns from Verbs).

Innate components

Sound generation (consonants; vowels)

Innately recognized consonants

Innately processed vowel

The basics of Grammar are innate

Learning language requires a little effort

Innate components

Sound generation (consonants; vowels)

Innately recognized consonants

Innately processed vowel

The basics of Grammar are innate

Learning language requires a little effort

Specialized brain areas and genes

Summary

Human language as a species-specific cognitive ability (elements of language are innate)

Permit highly exact, extremely elaborate thinking, planning, coordination